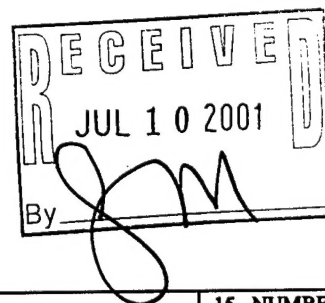


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13. ABSTRACT (Maximum 200 words) The project to study quantum transport in Si/SiGe heterostructures has, in addition to attacking the proposed goals, emphasized work on the two-dimensional metal-insulator transition. Ballistic Aharonov-Bohm devices were made and studied. The experimental results on the metal-insulator complement and sharply contrast with the results from much lower mobility systems like Si-MOSFETs. Data can be scaled according to an equation drawn from considerations of zero-temperature quantum critical points, but with a much larger conductivity (by a factor of nearly 100) than in the more generic (lower) mobility samples.				
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The specific original goal was an attempt to fabricate and study quantum wires and to use them to attack four problems in quantum transport:

- (1) study of ballistic transport in point contacts,
- (2) study Aharonov-Bohm interference in loops,
- (3) begin studies of Luttinger correlations in one-dimensional transport and
- (4) study of electrostatic effects in quantum interference.

The first two of these targets were accomplished, and the results are published two refereed articles:

"Observation of ballistic conductance and Aharonov-Bohm Oscillations in Si/SiGe heterostructures," *Applied Physics Letters*, **6** (1994) pp 3114-6, WX Gao, K Ismail, KY Lee, JO Chu and S Washburn;

"Fabrication of Aharonov-Bohm rings in Si/SiGe heterostructures," *Microelectronic Engineering*, **2** (1995) pp 79-82, KY Lee, K Ismail, JO Chu, WX Gao and S Washburn.

In these experiments small wires (widths down to  $0.2\mu\text{m}$ ) were wet or reactive ion etched into the cap and dopant layers of a high-mobility heterostructure. Schottky gates were then deposited across parts of the channel or over the entire device to permit carrier concentration in the conducting channels to be modulated. Ballistic channel widths down to less than  $0.3\mu\text{m}$  could be formed in this fashion. A back-gated permitted carrier concentration control in the entire device. Some details of the research have been given in previous annual reports as well.

The third target was also covered in the same experiments, but with no dramatic revelations about the correlated motion of the carriers. Hence no separate publications were submitted as the results did not warrant dissemination. Some of the results have been mentioned as illustrative data in publications such as:

"Some consequences of chaos for quantum devices," in *Quantum Based Electronic Devices and Systems*, ed: MA Strosio and M Dutta (World Scientific, Singapore, 1998); Int J High Speed Electron Syst, **9**, 209-22 (1998). S Washburn.

"Resource Letter QIMS-1: Quantum Interference in Macroscopic Samples," *Am J Phys*, **63**, 683--93 (1995). (invited) S Das Sarma, T Kawamura and S Washburn.

The fourth target consumed much of the time. It was discovered during the course of the grant that the moderately high-mobility two dimensional electron or hole systems are behaving as if the carriers undergo a transition from the insulating behavior expected for non-interacting carriers (where conductivity decreases with decreasing temperature) to a metallic "state" where the opposite trend appears. This appears to be an extension of granular systems in which a superconductor-insulator transition has been studied since the late 1980's. The following publications contain the results from these experiments.

"Metal-Insulator Transition in Two Dimensions: Effects of Disorder and Magnetic Field," *Phys Rev Lett*, **79**, 1543-6 (1997). D Popovic, A Fowler and S Washburn.

Comment on "Electric Field Scaling at  $B=0$  Metal-Insulator Transition in Two Dimensions," cond-mat/9707061. K Ismail, JO Chu, D Popovic, A Fowler and S Washburn.

"Conductance Fluctuations Near the Two-Dimensional Metal-Insulator Transition," Int. Conf. Electronic Properties of Two-Dimensional Systems, *Physica B*, **249-251**, 504-7 (1998). KP Li, D Popovic and S Washburn.

"Metal-Insulator Transition in a low-mobility two-dimensional electron gas," Int. Conf. Electronic Properties of Two-Dimensional Systems, *Physica B*, **249-251**, 701-4 (1998). D Popovic, AB Fowler and S Washburn.

"Absence of Localization in Certain Field Effect Transistors," *Superlattices and Microstructures*, **23**, 581-91 (1998). (invited) S Washburn, D Popovic, KP Li and AB Fowler.

"Scaling and universal behavior near the two-dimensional metal-insulator transition" Proc. 22nd Int School Theoretical Physics, Ustron, 10-15 Sept 1998; *Mol Phys Rept*, **24**, 150-7 (1999). (invited) S Washburn, NJ Kim, KP Li and D Popovic.

In addition to the publications, the grant supported the final year of PhD training for WX Gao (now employed at SGS-Thomson), and the first two years of the training for NJ Kim (accepted a postdoc at Case Western Reserve) who will defend his dissertation later this month. It also provided partial support for travel to conferences and contributed talks by the students once each year as well as partial support for the PI to deliver invited lectures at NC State University, University of Cincinnati, University of Virginia and the 22<sup>nd</sup> International School of Theoretical Physics.

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